metallurgy. A satisfactory feature of the book is the calculation of furnace charges in reference to typical metallurgical operations. As has been generally indicated, the book gives a good, if at times too brief, account of the principal operations involved in the metallurgy of the six metals discussed. It is well printed, particularly well illustrated, and bears evidence of careful and judicious preparation.

H. C. H. C.

Scientific Activities in the United States: A Biologist's View.

Universities and Scientific Life in the United States. By Prof. Maurice Caullery. Translated by James H. Woods and Emmet Russell. Pp. xvii + 269. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1922.) 10*s.* 6*d.* net.

BEFORE the war inter-university exchange of professors was much in vogue as between Germany and America. More recently several exchanges of this kind have taken place between America and France, and Prof. Caullery's book is a result—a very useful result—of one of these exchanges. It gives a remarkably lucid and sympathetic interpretation of impressions received by the writer during a stay of five months in America in 1916, when he filled the post of exchange professor of biology at Harvard and visited many of the principal seats of learning in the United States.

The greater part of the book is devoted to the universities and colleges as centres of research and as providing the environment in which future workers are trained. These institutions have, in general, envisaged as their main task the training and equipment of their students for successful leadership in all branches of social activity; and they have come to recognise that with the incessant extension of the fields of application of science to social needs it concerns them to provide the best possible teaching in applied as well as in pure science. Thus the tendency is for science, as the basis of preparation for practical life, to inspire all the activity of the university.

It is sometimes asserted that the study of science in America is apt to be cramped by an excessively utilitarian bias, and such a bias has undoubtedly characterised the State universities, most of which originated in the "Colleges for Agriculture and Mechanic Arts" established under the Morrill Act of 1862. The policy inaugurated by this Act was one which Congress adopted owing to the refusal of the independent colleges to provide urgently needed teaching in technology. About the same time the growth of scientific knowledge led to the breaking down of the old uniform curriculum and its replacement by the elective system, and to the organisation of "Graduate Schools" by the more important colleges, which thus became full universities and began to cultivate a spirit of original research. Competition with the new State universities soon led to the abandonment of the attitude of aloofness in regard to applied science and proved beneficial to the interests of pure science, both because the broadening of the basis of studies in the old institutions brought them into closer touch with the nation at large and greatly increased their prosperity and resources, including laboratory equipment, and because the State universities have made, and continue to make, successful efforts towards rivalling the others in the cultivation of scientific research of all kinds.

In this connexion Prof. Caullery is able to elucidate and point his argument by reference to science progress in French institutions, where the Napoleonic system of public instruction has shown itself deficient in adaptability to changed conditions and faculties of science have few points of contact with schools of technology. In America adaptation to their environment is reflected in the remarkable growth shown by the universities and colleges during the past thirty years. The student population of the collegiate and graduate departments has twice doubled within this period, and shows, according to statistics summarised recently in NATURE of April 1, p. 425, no tendency towards abatement of this rate of progress. Buildings and equipment have more than kept pace, their value having increased from 108*l.* to 279*l.* per student, and this is due largely to the enormous development of laboratories which has taken place in all branches of science. Recent visitors to the United States are unanimous in admiring the wealth of material equipment for science teaching and research, and some even describe it as excessive. This development has been made possible by a belief, prevalent among all classes of the community, in the practical value of such work and, especially for the private universities, by the spirit of intense loyalty to the Alma Mater on the part of college graduates. The Harvard rule, that at the twenty-fifth anniversary of graduation each class gives the university a sum of 100,000 dollars, affords an example of the very practical forms in which this spirit manifests itself.

When the Graduate School movement began there arose a demand for facilities for scientific research, and, as this could not at the time be met in America, students resorted to Europe, and found that of European countries, Germany best suited their requirements.

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A tradition of Germany's scientific supremacy became firmly established, and for forty years America's most promising young workers, coming under the spell of this tradition, became for life " intellectual subjects of Germany." A reaction had begun to set in before the war, and has acquired considerable force, but the German influence on American science has been profound and its effects will be lasting.

Scientific research is unanimously recognised by American intellectuals as an essential function of the university, but while the material requisites for it have been abundantly supplied, there exist certain other conditions less favourable to its development. Students come up to the university ill prepared as regards both acquisition of knowledge and intellectual discipline. Like many other observers, Prof. Caullery regards secondary school teaching as the weakest part of the American system of education. It is, he says, not merely that the college is burdened with the task of imparting knowledge which should have been acquired in the high school, but that the schools defer too much to the taste, or rather whim, of the pupil. "Americans try to compel the child as little as possible, to present life to it under its most smiling form, to spare it opposition, to make work appear to it under the form of pleasure rather than of duty . . . ; they treat the schoolboy too much like a student, to the detriment of healthy intellectual discipline." The " spoon feeding " which is consequently resorted to in the college (where the student is apt to be treated too much like a schoolboy) is unfavourable to the development of capacity for original work. While this does not prevent the colleges from turning out graduates well qualified to achieve success in life, nor stifle the development of exceptionally gifted individuals, in the average case the college gives " a culture not sufficiently deep to be fertile."

The connexion between the college and the graduate school of the University, in which most of the advanced work in pure science is done, is very close. In all except a few of those universities (about thirty) in which a graduate school has been developed, it has no separate teaching staff: its professors are also those of the undergraduate college, although the work is organised quite separately, and is carried out under the superintendence of the Dean of the school. In most universities, moreover, the college tradition, with its emphasis on athletics and the social side of life, is still dominant. Some high authorities in America who believe that the destiny of the universities is to become primarily great schools of research have urged that the time has come to free the graduate school from this domination. Meanwhile there is a clear tendency to create special institutes for research within more or less narrow limits, some being established within, or in association with, the universities and others with no such connexion.

As regards the actual contributions to science of American universities, Prof. Caullery notes that in zoology and general biology, the sciences in which he is specially interested, they have produced of late years many very remarkable works. He instances those of Edmund Wilson (cytology), E. Conklin (cell-lineage), R. G. Harrison (experimental embryology), T. H. Morgan (Mendelian heredity and mutations in Drosophila), Calkins and Woodruff (Infusoria, senescence, etc.), and others.

Scientific activities outside the universities and colleges are dealt with by Prof. Caullery in a series of interesting sketches of the more important of the research institutes, the Carnegie and Rockefeller and other foundations for promoting research, the great museums, the Federal scientific services, and the scientific academies and societies. From the first category the Mellon Institute for Industrial Research may be selected as an example of an establishment for pure research attached to a university—Pittsburgh—but retaining a large measure of autonomy. A manufacturer having a problem to solve turns it over with a definite sum of money to the Institute, which proceeds to engage the services of a man of science and provides the requisite laboratories and equipment. The man of science, who is styled a fellow, conducts his researches in secrecy, and the results are the property of the donor of the subvention. The plan is reported to have worked very successfully.

For an indication of the scale on which scientific research is being fostered by these various bodies (except the Federal services) and by great industrial corporations, one may refer to a bulletin published last year by the National Research Council, now the chief agency for co-ordinating scientific research in America. This bulletin (noticed in NATURE of August 4 last) enumerated 170 bodies other than universities and colleges which provided funds for this purpose of the aggregate annual value in 1920 of more than 18 million dollars. The Government (Federal and State) grants for research in agriculture, engineering, and the industrial arts have been estimated to amount to 10 million dollars in 1921.

Our Bookshelf.

A Text-book of Wood. By Herbert Stone. Pp. vii + 240 + 41 Plates. (London: Rider and Son, Ltd., 1921.) 21*s.* net.

THIS book deals with the anatomy, physical and mechanical properties, anomalies, defects, and decay of wood. Although intended for " advanced students,"

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